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Amino Acid Based Biodegradable Poly (Ester-Amide)s and Their Potential Biomedical Applications as Drug Delivery Containers and Antibacterial

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Abstract : Amino acid-based Biodegradable poly(ester-amide)s (PEAs) have gained considerable interest as a promising materials for numerous biomedical applications. These polymers reveal a high biocompatibility and easily form small particles suitable for delivery various biological, as well as elastic bio-erodible films serving as matrices for constructing antibacterial coatings. In the present work we have demonstrated a potential of the PEAs for two applications: 1. cell therapy for stroke as vehicles for delivery and sustained release of growth factors, 2. bactericidal coating as prevention biofilm and applicable in infected wound management. Stroke remains the main cause of adult disability with limited treatment options. Although stem cell therapy is a promising strategy, it still requires improvement of cell survival, differentiation and tissue modulation. .Recently, microspheres (MPs) made of biodegradable polymers have gained significant attention for providing necessary support of transplanted cells. To investigate this strategy in the cell therapy of stroke, MPs loaded with transcription factors Wnt3A/BMP4 were prepared. These proteins have been shown to mediate the maturation of the cortical neurons. We have suggested that implantation of these materials could create a suitable microenvironment for implanted cells. Particles with spherical shape, porous surface, and 5-40 □m in size (monitored by scanning electron microscopy) were made on the basis of the original PEA composed of adipic acid, L-phenylalanine and 1,4-butanediol. After 4 months transplantation of MPs in rodent brain, no inflammation was observed. Additionally, factors were successfully released from MPs and affected neuronal cell differentiation in in vitro. The in vivo study using loaded MPs is in progress. Another severe problem in biomedicine is prevention of surgical devices from biofilm formation. Antimicrobial polymeric coatings are most effective “shields” to protect surfaces/devices from biofilm formation. Among matrices for constructing the coatings preference should be given to bio-erodible polymers. Such types of coatings will play a role of “unstable seating” that will not allow bacteria to occupy the surface. In other words, bio-erodible coatings would be discomfort shelter for bacteria that along with releasing “killers of bacteria” should prevent the formation of biofilm. For this purpose, we selected an original biodegradable PEA composed of L-leucine, 1,6-hexanediol and sebacic acid as a bio-erodible matrix, and nanosilver (AgNPs) as a bactericidal agent (“killer of bacteria”). Such nanocomposite material is also promising in treatment of superficial wound and ulcer. The solubility of the PEA in ethanol allows to reduce AgNO3 to NPs directly in the solution, where the solvent served as a reductive agent, and the PEA served as NPs stabilizer. The photochemical reduction was selected as a basic method to form NPs. The obtained AgNPs were characterized by UV-spectroscopy, transmission electron microscope (TEM), and dynamic light scattering (DLS). According to the UV-data and TEM data the photochemical reduction resulted in spherical AgNPs with wide particle size distribution with a high contribution of the particles below 10 nm that are known as responsible for bactericidal activity of AgNPs. DLS study showed that average size of nanoparticles formed after photo-reduction in ethanol solution ranged within ca. 50 nm.

Keywords : biodegradable polymers, microparticles, nanocomposites, stem cell therapy, stroke
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